TELEMETRY SPECTRUM ENCROACHMENT— LESSONS LEARNED

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Abstract

Over the past five years the United States (US) Congress has passed legislation mandating the reallocation of 255 MHz of radio frequency bands from Federal to non-Federal or "MIXED USE." Several of the frequency bands supporting telemetering functions were affected, and more legislation of this nature is forecasted, both in the US and in numerous countries around the world. This threat **can** be met and countered by the international telemetering community if the "Lessons Learned" in the last five years are adapted.

Introduction

Aeronautical flight testing is an expensive, technically sophisticated and, at times, dangerous production. A number of complex and organizationally independent functions must be successfully coordinated to complete a mission. Examples of some of these are: range safety, chase aircraft, weather, radars, recorders, and, of course, aeronautical telemetry support. Because a mission relies on so many disparate factors, the availability of sufficient dedicated frequencies and frequency bands is essential.

The US aeronautical flight test community is heavily dependent on access to four portions of the electromagnetic spectrum. Specifically, the 1435-1525 MHz and 2310-2390 MHz bands (also referred to as "L-Band" and "Upper S-Band" respectively) are used by the US Department of Defense (DOD), the National Aeronautics and Space Administration and the civil aerospace industry for the development and checkout of manned aircraft. The 2200-2290 MHz band ("Lower S-Band") is restricted to telemetering of unmanned flight vehicles such as drones and missiles. Although the 1710-1850 MHz band was reallocated to other functions many years ago, several ranges still retain frequency assignments in this band for air/ground video telemetry operations. Loss of access to these bands, or portions of these bands, would have a significant cost to the US telemetering community.

Body

A Bit of History . . .

The history of this issue really began back in the 1920's, when the US Federal Government first began allocating the nation's electromagnetic spectrum. From then until the early 1980's the Government gave away free airway licenses after hearings in which applicants competed to prove who was worthiest. After that slow and complicated system broke down in 1984, the Federal Communications Commission (FCC) tried another scheme: the licenses were still free, but distributed by random selection, or lotteries. This new system was a fiasco. Sensing a no-risk opportunity, hoards of speculators (and not a few charlatans) banded together as quickie companies to join these lotteries—**400,000** "firms" for cellular telephone licenses alone. After paying nothing at all, lottery winners were free to turn around and sell their valuable rights. For example, the RCDG partnership, which won a cellular license for Cape Cod, Massachusetts, in December 1989, never spent a dime to put its system on the air. Instead, investors sold their windfall 10 months later to Southernwestern Bell Corp. for $41.5 million. The FCC figures that 85% of the cellular licenses awarded to firms other than local telephone companies changed hands from 1984 to 1992. Transition fees to cellular license brokers **alone** topped $1 billion. The cellular licenses the Government gave away in the 1980's were worth an estimated (by the US Department of Commerce) $46 billion.

Ever since the late 1950's, economists such Nobel Prize winner Ronald Coase argued that it was absurd for the FCC to give out those licenses for free. The Treasury was passing up billions of dollars that could be used to reduce the US Federal Deficit. Auctions were also the most economically efficient way to allocate any scarce resource. The reasoning was that those who value something the most normally would use it the best. Finally, in August 1993, a wiser Congress passed the Communications Licensing and Spectrum Allocation Improvement Act, allowing the sale of spectrum rights.

The Grab (Part 1)

Eighteen months later, then-USA Secretary of Commerce Ronald H. Brown issued the National Telecommunications and Information Administration's (NTIA) "Spectrum Reallocation Final Report." Mandated by Title IV of the Omnibus Budget Reconciliation Act of 1993 (OBRA-93), this report identified 235 MHz of radio frequency bands (including our 1710-1755 MHz band) for reallocation from Federal to non-Federal or "MIXED USE*."

*Four of the reallocated bands were designated "MIXED USE." This means that limited amounts of some classes of Federal transmitters will be conditionally permitted to operate in these bands. In addition to this clemency, the transfer of certain bands at specified locations will be delayed (in many cases indefinitely) to protect certain high-value users.

Why?
There were three primary objectives to this legislation. The first was to increase the efficiency of spectrum use and the effectiveness of the spectrum management process. The second, to promote and encourage the use of new spectrum-based technologies in telecommunications applications. The third, to add several billion dollars to Government coffers through competitive bidding (auctions) for the reassignment and licensing of the reallocated bands to the private sector by the FCC.

Why Us?
These noble goals were of little comfort to those spectrum orphans who were expected to:

- Locate unoccupied Government spectrum and get replacement assignments for their expelled equipment. With fewer frequency bands and more systems, accommodate, spectrum congestion and increased conflict.
- In some cases, totally re-engineer the expelled equipment to fit the characteristics and standards of the new band; a wretched and expensive burden. Since Title VI did not provide a mechanism to compensate Federal agencies for the costs of this reallocation, the **user** was responsible for funding, converting, retuning and replacing his displaced frequencies and equipment.

The NTIA was tasked to research and identify the spectrum for reallocation. To make the transfer as painless and efficient as possible, the NTIA sought out the Government spectrum that:

- Was not required for the Government's present or future needs.
- If transferred, would not result in costs or loss of services that were excessive in relation to the benefits.
- Had the greatest potential for productive uses and public benefits (and auction profits) when sold to the private sector.

OBRA-93 was more of a nuisance than a handicap to the telemetering community. Although the few remaining telemetry assignments in the 1710-1755 MHz band were deleted, the rest of the 1755-1850 MHz band remained in our hands.

In summary, after two years of thorough search and sometimes painful negotiation the NTIA succeeded in minimizing the reallocation impact to most Federal users. Of the thousands of types of emitters used by Government agencies, just a few dozen were affected to any extent. Most of these lost a fraction of their allocated operating band, meaning their operators would

merely have to shift their assignments a few MHz up or down. Only a few major systems, none of them telemetering, were seriously impacted.

The Grab (Part 2)

However, despite the word "FINAL" in the title of the reallocation report, the raids on Federally-allocated spectrum continued. When the initial spectrum auctions produced several billion quick and painless dollars for the US Treasury, members of Congress took notice and generated further spectrum reallocation proposals, many of them rash and irresponsible. On 7 June 1995, Senate Bill S.888 was brought before a vote. This bill proposed reallocation of another 275 MHz of Government spectrum, including the entire 225-400 MHz band. In 1993 the US DOD declared that the 225-400 MHz band was the single most critical spectrum resource of the military tactical forces, both nationally and within the North Atlantic Treaty Organization. Despite this proclamation Bill S.888 **passed** by a voice vote. Once the Bill passed the US House of Representatives and was signed into law by the President the DOD would have nine months to vacate the band.

The US DOD was stunned. Not only had the Senate totally overlooked the significance of the band to the national defense but the DOD had no notice this Bill was even being contemplated until the day of the vote. The resulting outcry quickly persuaded the Senate to strike the "reallocation of the 225-400 MHz band" provision from the Bill, but the DOD knew this was just a brief respite. Realizing the gravity of the threat to its electromagnetic spectrum assets the DOD mobilized to:

- Ensure there are no more breakdowns in liaison between the DOD and Congress concerning proposed spectrum reallocation legislation.
- Educate all echelons of the DOD on the criticality of access to the electromagnetic spectrum and the threat spectrum encroachment posed to its mission.
- Document and justify its use and possession of its remaining frequency bands against further encroachment.
- Predict the access it will have to crucial spectrum assets in the near and far terms; an access largely dependent on national-level legislating and budgeting whims.

There were other circumstances that slowed the impetus of the reallocation frenzy. Pressured by a voracious Congress, the FCC increased the pace of the spectrum auctions. As a result too much spectrum was dumped on the market too soon, resulting in a glut. One auction was predicted to pull in about $1.8 billion; instead it only raised $13.6 million, or less than 1% of the expected amount. At the same time many of the earlier auction winners were declaring bankruptcy; they belatedly discovered that neither the market or

the required technology was prepared to accommodate their pricey electromagnetic investments.

Despite these alarms, on 8 August 1997, President Clinton signed into law the Balanced Budget Act of 1997 (BBA-97). Title III of the BBA required the Federal Government to surrender 20 more MHz of spectrum below 3 GHz for future auctions no later than 8 February 1998. It is important to note that the BBA-97 required identification of reallocatable frequencies in a report to the Congress within six months. In contrast, the report to Congress on OBRA-93 was submitted after 18 months of analysis and negotiation.

This loss included the 2385-2390 MHz band. This band is used at US DOD test ranges and by the private sector aerospace industry for flight test telemetry for manned aircraft such as the F/A-18E/F, V-22, F-22, Joint Strike Fighter and the Boeing 777. Since the 2310-2360 MHz band was reallocated in 1992 to the Digital Audio Broadcasting industry, its usability will soon be lost to the flight test community. Loss of the 2385-2390 MHz band will mean increased program schedule slippage and range operations costs because only 25 MHz of spectrum (2360-2385 MHz) will be available for aeronautical telemetry in the Upper S-Band.

A Hard-Earned Success

Recently however, the US DOD and telemetering community won a victory, and a consequential one at that. On 5 October 2000, President Clinton signed into law the "National Defense Authorization Act for Fiscal Year 2000." The first provision of Section 1062 ("Assessment of Electromagnetic Spectrum Reallocation") requires the NTIA ***to return*** a total of eight MHz of spectrum recently reallocated by BBA-97. We **will not** have to provide alternative spectrum to replace the returned eight MHz. Still, the loss of the 235 MHz to the OBRA-93 and the remaining 12 MHz to the BBA-97, which includes 2385-2390 MHz, remains unchanged.

But more significant, Section 1062 also authorizes the future surrender of frequencies **only** if the Secretary of Defense, the Chairman of the Joint Chiefs of Staff, and the Secretary of Commerce jointly certify to Congress that this surrender will not degrade essential military capability. If necessary, alternative frequencies with the necessary comparable technical characteristics would have to be identified and made available to the DOD to restore the essential military capability lost.

Finally, the Act directs an interagency review, assessment and report to Congress and the President on the progress made in implementation of national spectrum planning, the

reallocation of Federal Government spectrum to non-Federal use, and the implications of such reallocations to the affected federal agencies. The report (due 1 October 2000) is to include the effects of the reallocation on critical military and intelligence capabilities, civil space programs, and other Federal Government systems used to protect public safety.

Lessons Learned

Not surprisingly, other country's governments have been following the reallocation efforts and results (particularly the auction revenues) of the US Government with keen interest. Dozens of them (if they haven't already) intend to start their own spectrum reallocation/auctioning programs, while hopefully avoiding the mistakes of their American cousins. The frequency management and telemetering communities in the US are grizzled, hardened veterans of the spectrum encroachment wars. From them we can glean several valuable strategies to survive, influence and perhaps even win the upcoming spectrum conflicts:

- **Organize/Mobilize/Educate Your Community.**

Reallocation legislation adversely affects numerous spectrum users, commercial and Federal, individuals and agencies. They are all potential allies in your efforts to survive. Bringing them into the fold focuses their efforts and prevents wasteful duplication of effort. Most important this allows your community to speak as **one voice**. This consistency will impress and be appreciated by the harried policy-makers. If your leadership cannot look past ancient quarrels/slights, egos and petty rivalries to forge an effective coalition with other organizations then they need to be replaced with personalities who can. The stakes are that significant.

The frequency management and telemetering communities quickly realized that few people comprehended the importance of our continued access to the electromagnetic spectrum. We began a concerted effort to alert, brief and periodically update the players (especially the important ones) on our concerns, positions and solutions. Also, this education served as a "rumor control" to head off much of the counterproductive speculation and misconception that followed the different surges of reallocation legislative proposals.

One promising assemblage is the International Consortium on Telemetry Frequencies (ITCS). Comprised of an international, diverse group of telemetry practitioners, it was recently established as an advocate for the protection and future availability of spectrum for telemetering.

- **Document/Justify Your Usage NOW.**

You will be expected to present your plea for continued usage of a candidate frequency band

in writing, the more detailed and voluminous the better. Concentrate on operational and monetary impacts to your valuable service; all other factors are given little consideration. Since you will usually have little or no time to respond to a data call, begin compiling the pertinent statistics, usage surveys and position statements **now**. Continuously update them. If you **do not** respond, or respond in what is perceived to be a half-hearted manner, the policy-makers will assume that the candidate band is not important to you and proceed accordingly.

- **Make Your Spectrum Assets As Unappetizing As Possible.**

The reallocators are looking for readily available, commercially attractive spectrum, not a war. Your motto: "We may not win this fight but I promise you won't win it either. I will come after you like a rabid dog." If they become convinced that even a cursive examination of your turf will automatically earn them a bloody nose they will learn to avoid you and your property. Their reallocation efforts **will** go on, but will then be directed toward bands that have less alert and zealous defenders.

- **Make Relocation THEIR Burden, Not Yours.**

Despite your gallant efforts you are about to lose a band or sub-band. Press for concessions, exemptions and delays. For example: "I will accept the nationwide reallocation gracefully IF I can retain band usage within a 50 kilometer radius of each of my six test sites" or "Because of a lack of funds I need an extra five years past the reallocation timetable to move to a new band."

This is not the time to be shy or defeatist. You **DEMAND** that the reallocators accommodate your legitimate needs: "**YOU** have booted me out of my telemetry bands, now **YOU** tell me ***where*** and ***how*** to move."

- **Don't Become Discouraged.**

Those of us in the US frequency management and telemetering communities never had to deal with an issue like this before. As a result we were tentative and clumsy in our initial efforts to confront it. Further confounding us was the non-stop bombardment of reallocation proposals we were expected to respond to immediately (remember: silence = concurrence). We were exhausted with the extra workload and demoralized by our impotence. At best it seemed we were fighting a haphazard rear-guard action.

But we learned and matured. We became more streamlined and politically sophisticated. Leaders emerged, we assumed a "war footing" and went on the offensive. And today we are seeing the results. Remember this is a long-term issue that will not go away or be resolved. *The Genie Is Out Of The Bottle*: everyone now knows the value of a finite resource like the radio

frequency spectrum will only increase, making it perpetually desired and contested.

Conclusion

Both the US House and Senate Commerce Committees predicted in the BBA-97 revenues of $26.3 billion over the first five years from spectrum sales. In light of recent shortfalls in predicted auction profits this figure is certainly over-optimistic. Still, while not the bottomless piggy bank some partisans anticipated, the spectrum sales **have** proven profitable, and Governments world-wide have noted this new possible source of revenue. As a result, the pressure on the international telemetering community to surrender more spectrum to commercial use for eventual auctioning will continue for the foreseeable future.

For more information consult the "DOD Spectrum Encroachment Intranet Page." This is an unclassified, continuously updated compendium of US spectrum reallocation-related documents, reports, bulletins, summaries and sources. It can be used as a tool for informing and educating other spectrum users and defending against loss of their spectrum assets. The Web Address is:

http://spectrum.nawcad.navy.mil

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Biography

Mr. Mikel R. Ryan is the Head of the Mid-Atlantic Area Frequency Coordination Office at the Naval Air Warfare Center Aircraft Division, Patuxent River, Maryland, USA. He served in the US Army 82nd Airborne Division and the 11th & 19th Special Forces Groups (Airborne), and retired a Master Sergeant in 1994. In September 1997, Mr. Ryan was given a Congressional Tribute by the HONORABLE Steny H. Hoyer (D-Maryland) for his tenure as the Chairman of the Frequency Management Group of the Range Commanders Council. Mr. Ryan has been heavily involved with defending Federal spectrum (especially telemetry) from reallocation since 1994.

Range Commanders Council

Mid-Atlantic Area Frequency Coordination Office

Telemetry Spectrum Encroachment ~Lessons Learned~

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European Telemetry Conference 2000
Garmisch-Partenkirchen Germany, 23 May 2000

Range Commanders Council

Mid-Atlantic Area Frequency Coordination Office

TELEMETRY SPECTRUM CRITICALITY

- **BANDS: 1435-1525, 1710-1850, 2200-2290 & 2310-2390 MHz**
- **CRITICAL TO TEST SAFETY**
  - **Monitors system performance & stability real-time.**
- **CRITICAL TO NATIONAL SECURITY**
  - **Virtually every defense system is tested in these bands.**
  - **Aircraft: F-16, F/A-18E/F, V-22, F-22, JSF, X-31.**
- **CRITICAL TO AEROSPACE INDUSTRY**
  - **Shortens flight test process; enhanced productivity.**

European Telemetry Conference 2000
Garmisch-Partenkirchen Germany, 23 May 2000

A BIT OF HISTORY . . .

- At first hearings before committees determined which applicants were "the worthiest."
- In 1984 the FCC distributed licenses by random selection:
  - Speculators dominated the lotteries.
  - 400,000 "Firms" for cellular telephone alone.
  - 85% of licenses awarded changed hands.
  - Transition fees of $1 billion for licenses worth $46 billion.
- AUG 1993: Congress allows the sale of spectrum rights.
  - Auctions were most economically efficient way to allocate any scarce resource; American tax payer benefits.

Omnibus Budget Reconciliation Act of 1993 (OBRA-93)

- 235 MHz of Federal spectrum (between 1390-4685 MHz) reallocated.
- Objectives:
  - Increase efficiency of spectrum use & management.
  - Promote new telecommunications technologies.
  - Gain billions of $$ through spectrum auctions.

OBRA-93 (Continued)

- Reallocated spectrum:
  - That was not required for present/future needs.
  - Whose future benefits outweighted the loss.
  - Had greatest potential when auctioned.
- Reallocation was a mere nuisance:
  - 1710-1755 MHz telemetry assignments deleted.
  - Few major systems seriously impacted.

Mid-Atlantic Area Frequency Coordination Office

Senate Bill S.888

- Passed by US Senate on 07 June 1995.
- Proposed reallocation of another 275 MHz including:
- 225-400 MHz: "Single most critical spectrum resource of the military tactical forces, both US & NATO."
- DoD mobilized:
  - No more breakdowns in liaison.
  - Educate DoD on criticality of spectrum access.
  - Document/justify spectrum use/possession.
  - Predict future access to spectrum assets.

Balanced Budget Act of 1997 (BBA-97)

- AUG 97: 20 MHz of Federal spectrum (between 139-2390 MHz) reallocated.
- 2385-2390 MHz aeronautical telemetry sub-band loss meant increased program slippage/range operations cost.

Mid-Atlantic Area Frequency Coordination Office

National Defense Authorization Act FY 2000

- President Clinton signed into law OCT 1999.
- Required NTIA to *return* 8 MHz of spectrum! (*Will not* have to provide alternative spectrum.)
- Authorizes future spectrum surrender *only* if SECDEF, CJCS & SECCOM jointly certify it will not degrade essential military capability.
- Directs interagency review/assessment/report on national spectrum planning by OCT 2000.

Range Commanders Council

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LESSONS LEARNED

- Organize/Mobilize/Educate Your Community
- Document/Justify Your Usage NOW.
- Make Your Spectrum Assets As Unappetizing As Possible.
- Make Relocation THEIR Burden, Not Yours.
- Don't Become Discouraged.

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